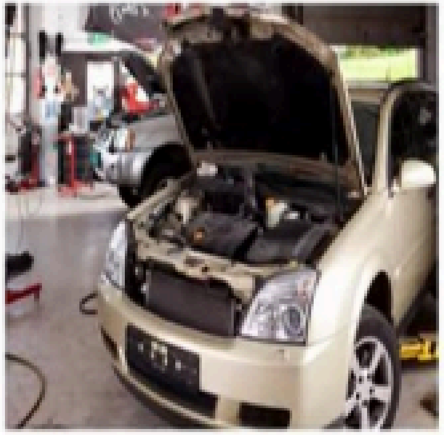
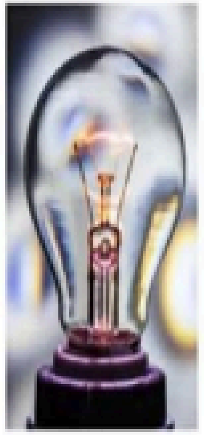

RELIABILITY
ENGINEERING
PRINCIPLES


20%
35%
45%
20%
x
y
PLAN
Plan
Company
Brand
Success

Reliability Indices

Failure Rate (λ)- A Reliability index that represents the **rate at which your product fails.**




Mean Time To Failure (MTTF) – The reliability index for ***<u>non-repairable units</u>*** represents the *mean time to failure.*

Mean Time Between Failure (MTBF) – The reliability index for ***<u>repairable units</u>*** represents the *mean time between failure.*

Reliability Indices

Failure Rate (λ)- A Reliability index that represents the **rate at which your product fails.**

$$\mathit{Failure\ Rate}\ (\lambda) = \frac{\mathit{Number\ of\ Failures}}{\mathit{Operating\ Time\ (Cycles)}} = \mathit{Failures\ Per\ Hour}$$

Mean Time To Failure (MTTF) – The reliability index for ***non-repairable units*** represents the *mean time to failure.*

Mean Time Between Failure (MTBF) – The reliability index for ***repairable units*** represents the *mean time between failure.*

$$\mathrm{MTTF} = \theta = \frac{\mathit{Operating\ Time\ (Cycle)}}{\mathit{Number\ of\ Failures}}$$

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RELIABILITY INDICES

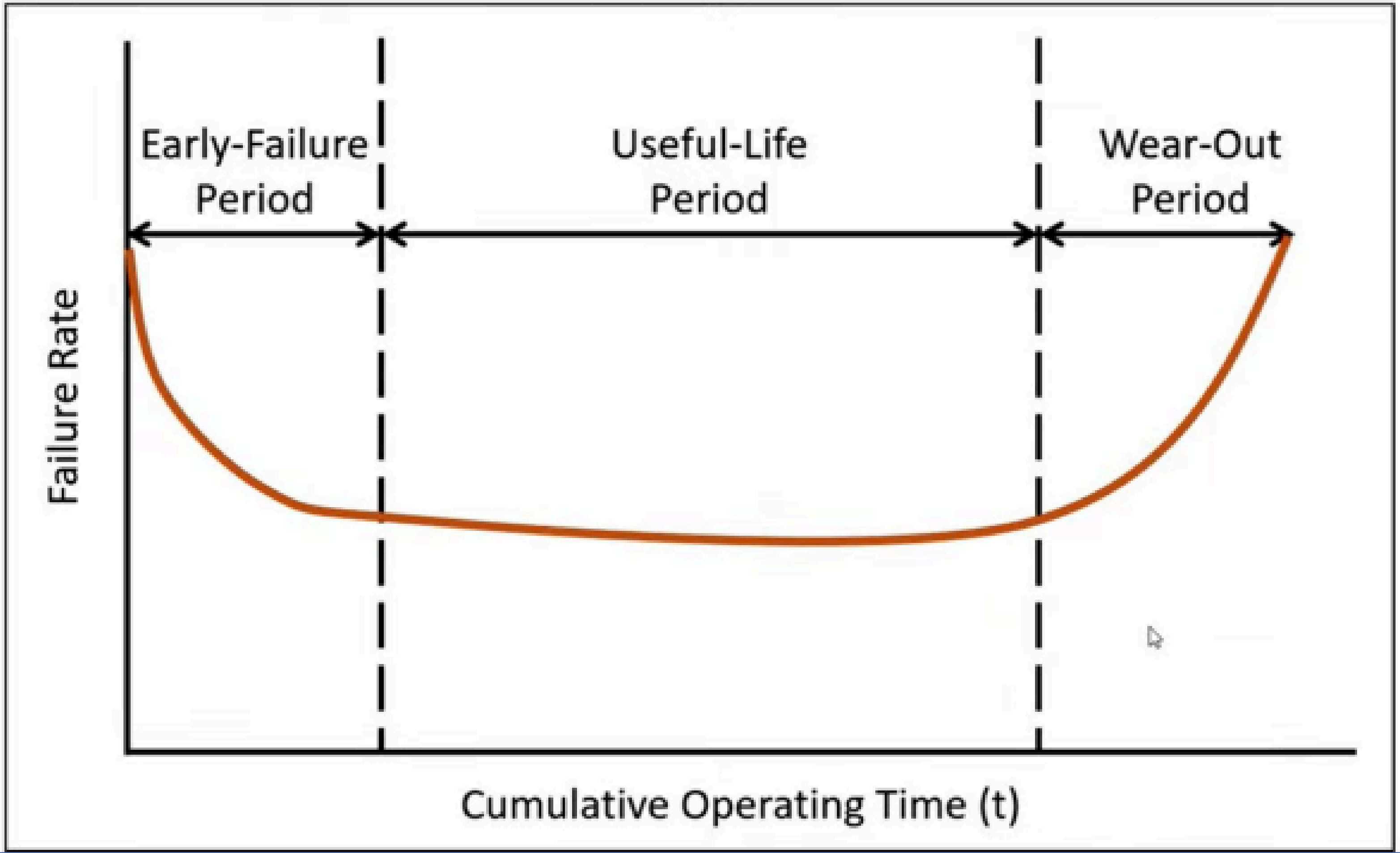
$$\textit{Reliability}: \quad R(t) = e^{-\lambda t}$$

$$\lambda = \textit{Failure Rate} = \frac{1}{\theta}$$

$$\textit{Reliability}: \quad R(t) = e^{-\left(\frac{t}{\theta}\right)}$$

The Bathtub Curve

The **bathtub curve** is a **reliability tool** that is used to **model the reliability of a unit** or system over the units **entire life**.



Reliability @ Different MTBFs

We've tested 20x units and found that our MTBF is 2,996 Hours. What is the reliability of our product at **1,200 hours of operation?**

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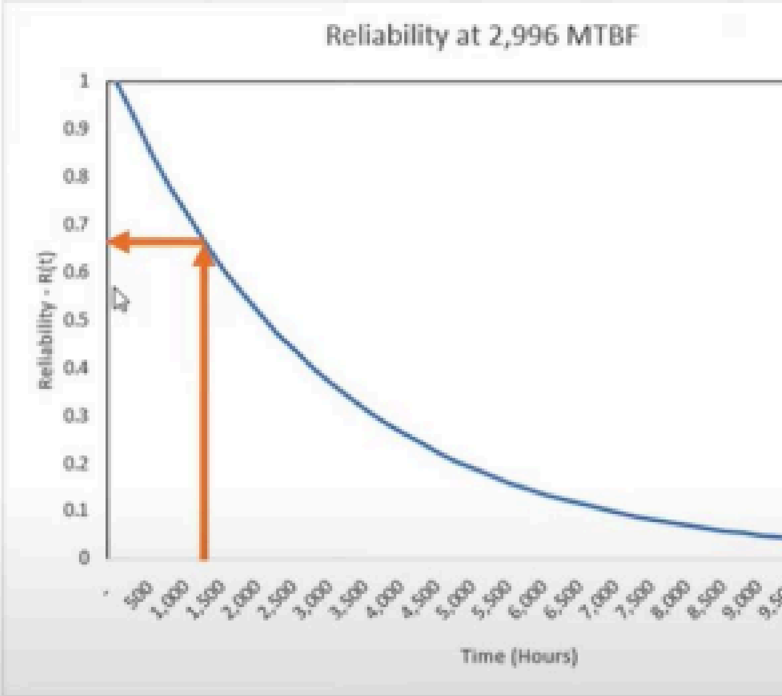


$$R(t) = e^{-\lambda t} = e^{-\frac{1}{\theta}(t)}$$

$$Failure\ Rate = \lambda = \frac{1}{\theta}$$

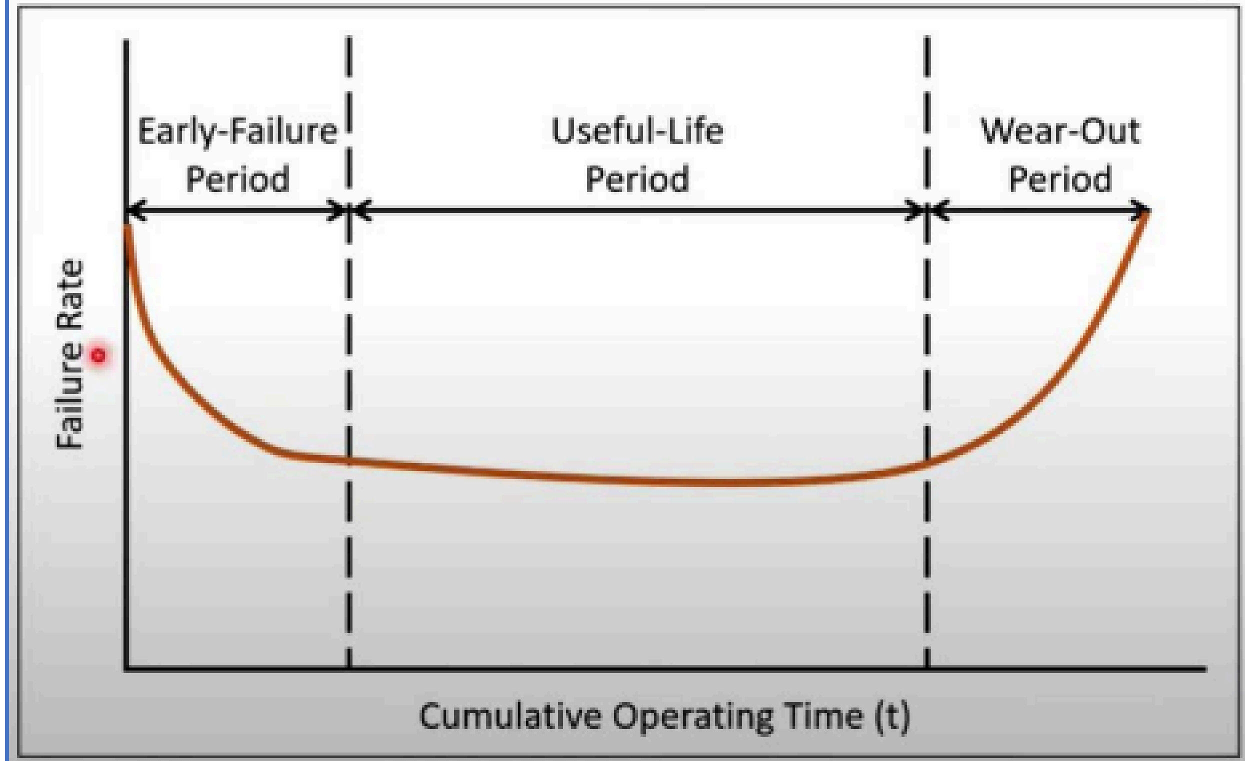
$$R(1,200) = e^{\frac{-1,200}{2,996}} = .6699$$

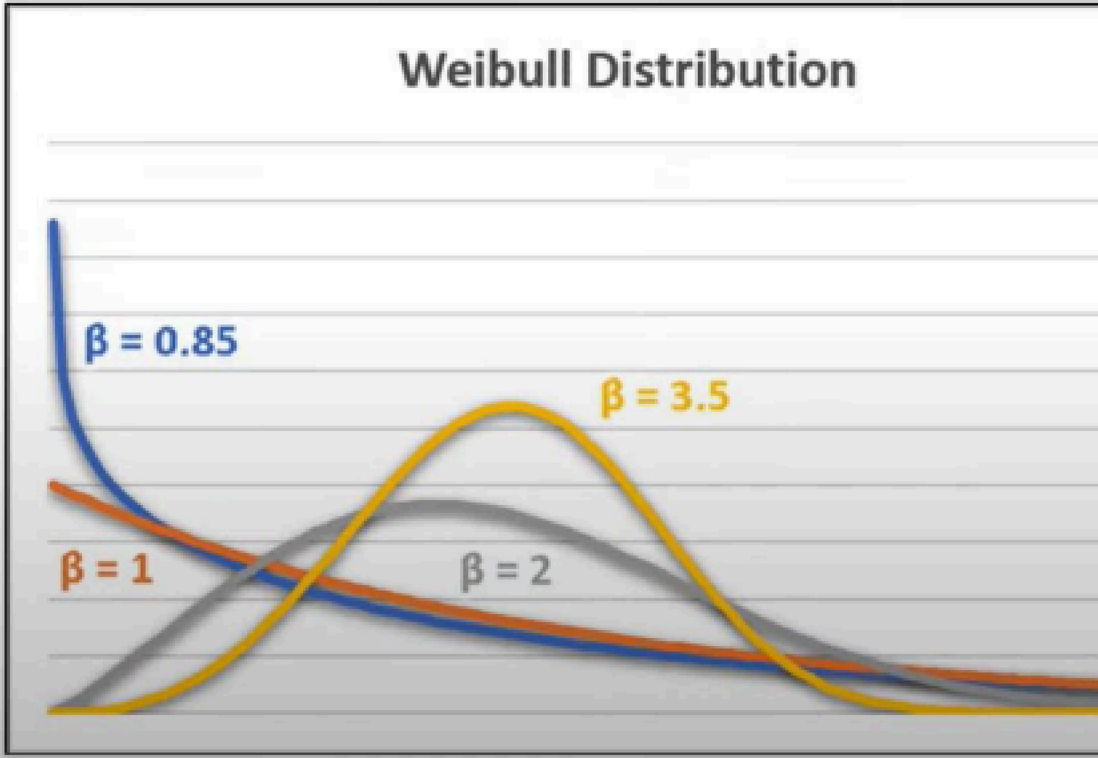
The probability that our product will perform successfully past the 1,200 hour mark is approximately 66

Alternative interpretation: 66% of the population of units can be expected to surpass the 1,200 hour m

The Weibull Distribution

The weibull distribution was discovered by **Waloddi Weibull** and is the most **versatile** distribution in Reliability Engineering because of its ability to **model a variety of distributions**.





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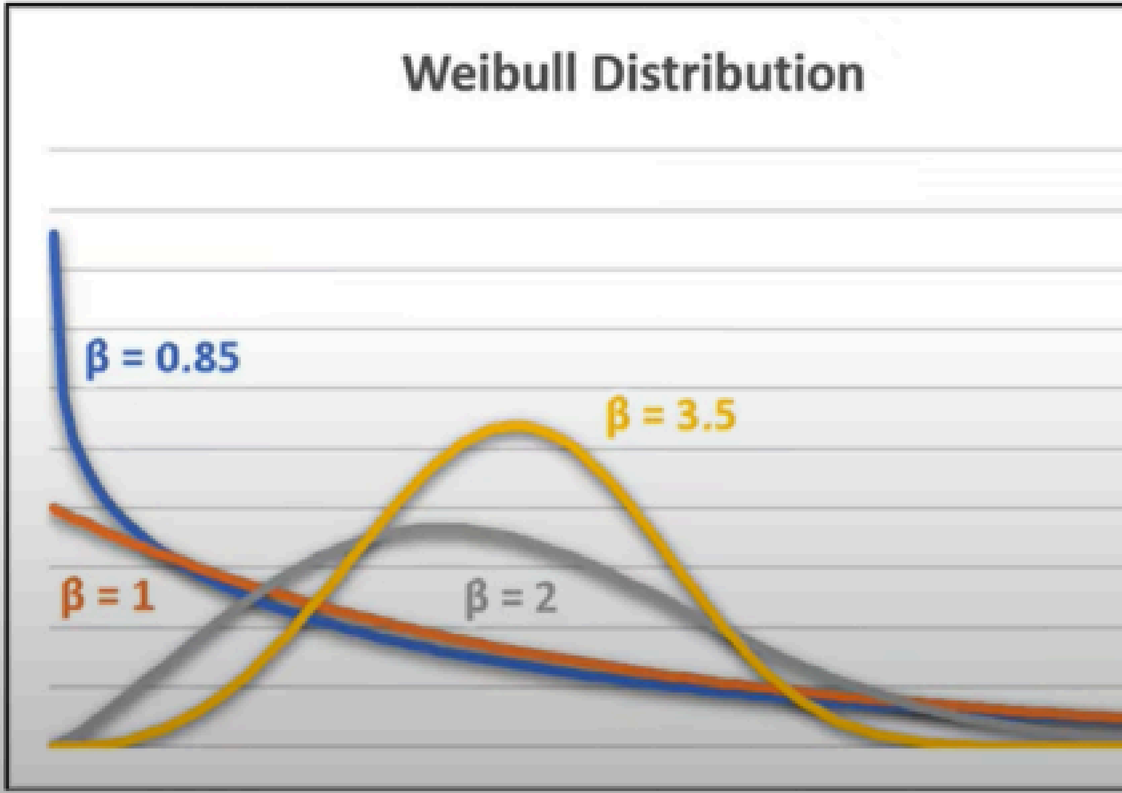
$$Reliability: \quad R(t) = e^{-\left(\frac{t}{\theta}\right)^{\beta}}$$

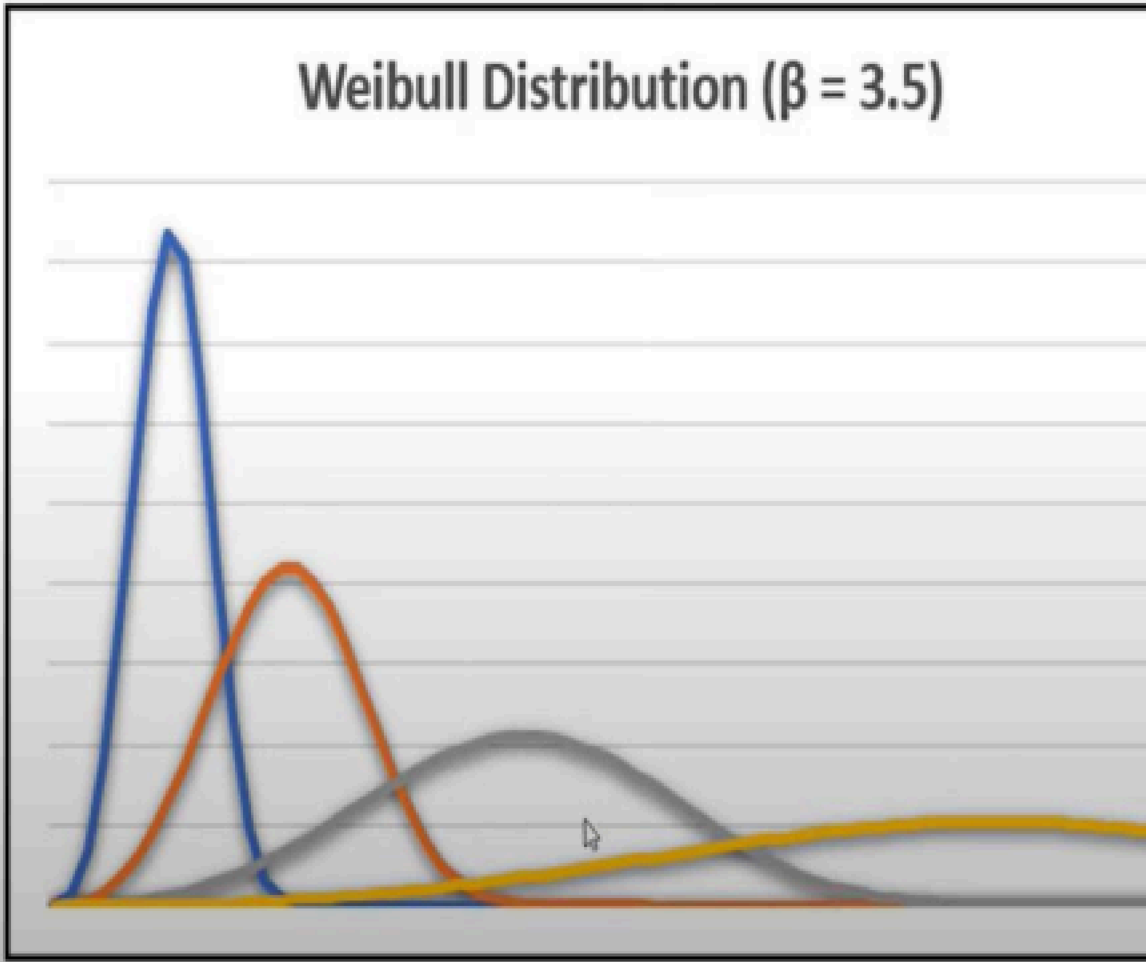
β **(Beta)** - the Weibull **Shape** Parameter



$$Reliability: \quad R(t) = e^{-\left(\frac{t}{\theta}\right)^{\beta}}$$

β**(Beta)** - the Weibull **Shape** Parameter

θ**(Theta)** - the Weibull **Scale** Parameter

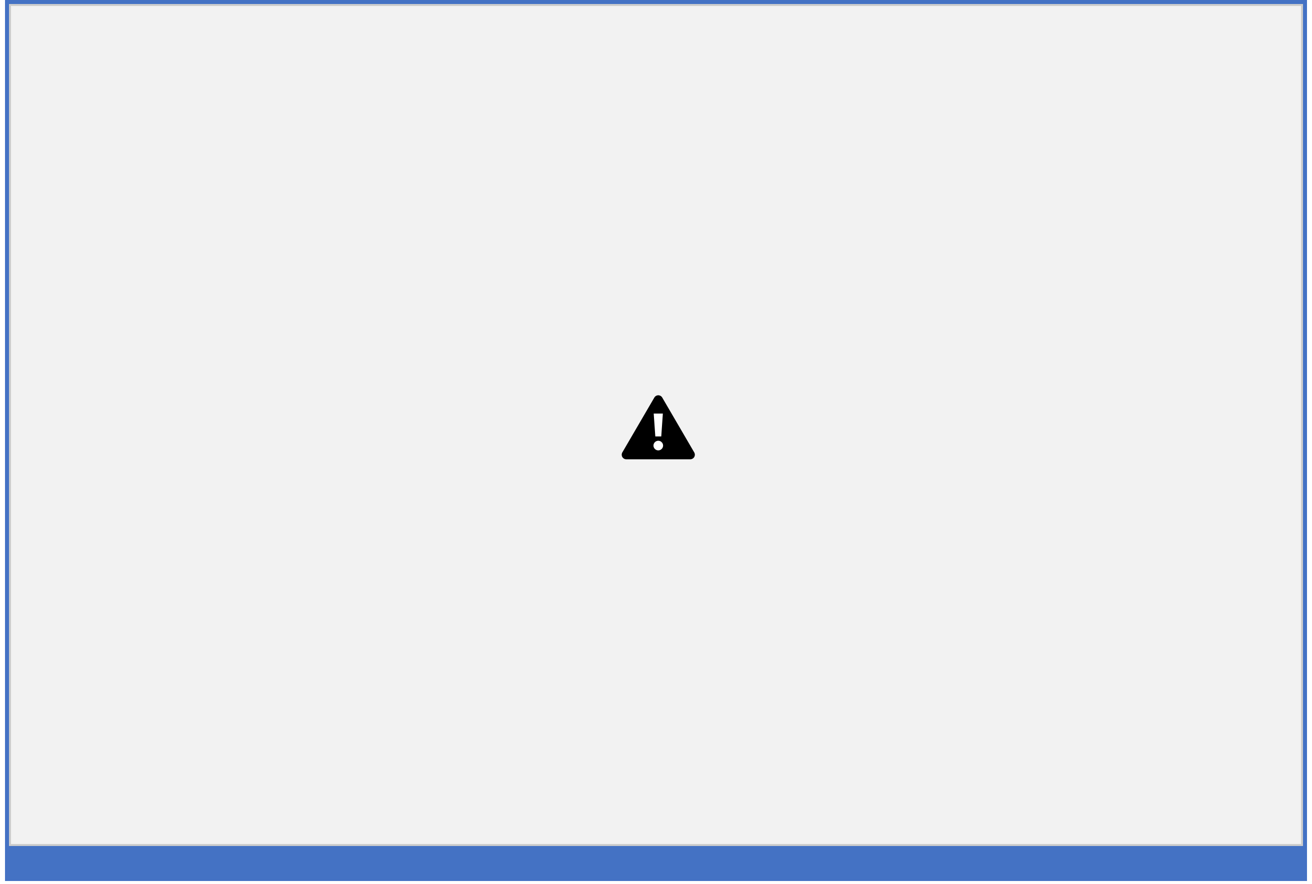


The Shape (Slope) Parameter

When **β < 1**, the weibull distribution represents a system with a **decreasing failure rate**

When **β = 1**, the weibull distribution is approximately equal to the **exponential distribution**

When **β > 1**, the weibull distribution represents a system with an **increasing failure rate**



https://www.youtube.com/playlist?list=PLeo7Pn9luLrW6-lexh_ilb2K2uUeb3ssX